



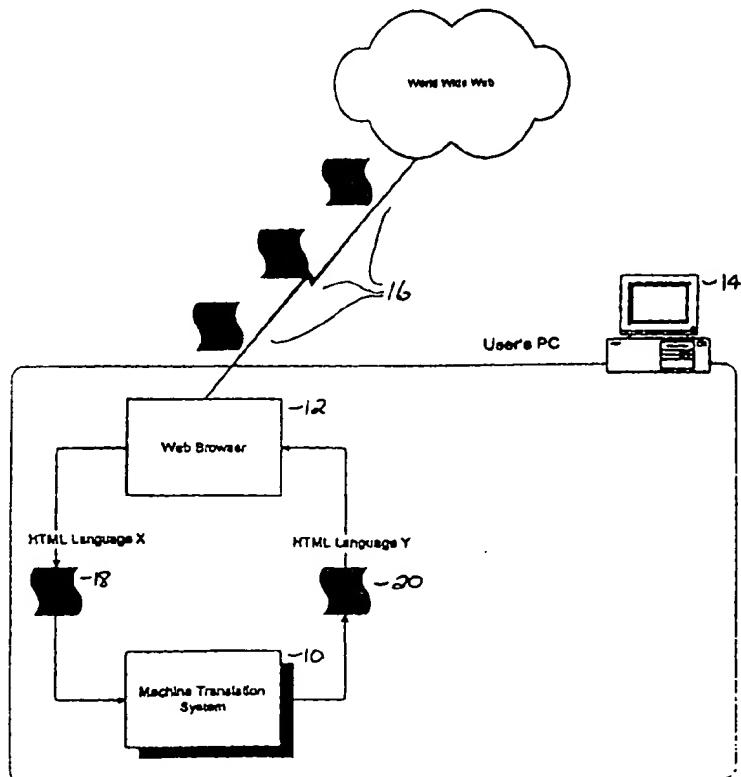
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: INTEGRATED MULTILINGUAL BROWSER

## (57) Abstract

The disclosed system translates into different languages HTML documents (16) available through the World Wide Web. HTML documents (16) are translated by machine translation software (10) bundled in a browser (12). Alternatively, documents are retrieved as needed, translated, and stored on a Web server so user requests are serviced with a document that has been translated from a different language. The disclosed invention expands usage of the Internet for non-English speakers.



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DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

**INTEGRATED MULTILINGUAL BROWSER**

5

**BACKGROUND AND SUMMARY OF THE INVENTION**

The present invention relates generally to the field of electronic communication over a computer network. Particularly, the present invention relates to the expansion of multi-lingual electronic communication through translation services for documents and messages available 10 through the Internet.

The recent surge in media attention to the Internet, and especially the World Wide Web, coupled with the continuing growth in home PC ownership have resulted in a growing diversity of the Internet user population. No longer is the Internet the province of software experts; thousands of novice users have begun to come online each day. Software like 15 CompuServe's Web Browser lets users quickly connect to and find useful content online. This phenomenon is not restricted to the United States or to English-speaking countries. Growth in online usage in Europe and Asia is increasing even more quickly than in the U.S.

While interest in the online world is at a peak, a significant obstacle exists to broad usage of the Internet for non-English speakers. The vast majority of Internet content is in 20 English, and is therefore inaccessible to users with other native languages. Translation of Internet documents by a human translator is not a practical solution for two reasons. First, human translation is costly and slow. A translator can typically produce 300-400 words per hour at costs of 12¢ per word or more. Second, in order to have a translator convert Internet documents to the user's native language, the user would have to download every document he 25 was interested in to provide it to the translator. This is a time-consuming process, and if the user knows no English, he will not even be able to assess the relevance of the document before

downloading it. This would result in wasted time and translation costs since inevitably, some of the documents selected will not prove to be worthwhile.

The present invention allows non-English speaking Internet users to access and understand information available from the World Wide Web and related sources. Language 5 translation software (known as machine translation, or MT) is combined with Internet software to allow non-English speaking Internet users to quickly generate translations of online text. The process is automated and therefore, less costly and time-consuming than human translation. Advantages of the present invention are explained further in relation to the following detailed description of the invention, drawings, and claims.

10

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1A and 1B comprise a screen shot of a World Wide Web page;

Figure 2 is an example of a hypertext document;

Figure 3 is an example of a hypertext document preprocessed according to the method 15 of the present invention;

Figure 4 illustrates a system for performing machine translation;

Figures 5A and 5B comprise an example of a preprocessed hypertext document translated according to the method of the present invention;

Figure 6 is an example of a translated hypertext document postprocessed according to 20 the method of the present invention;

Figures 7A and 7B comprise a screen shot of a World Wide Web page that has been translated according to the method of the present invention;

Figure 8 is a diagrammatic view of one embodiment of the present invention in which machine translation is integrated into a Web browser; and

Figure 9 is a diagrammatic view of one embodiment of the present invention in which pre-translated Web pages are accessible from a server.

#### DETAIL DESCRIPTION OF PREFERRED EMBODIMENT(S)

5        Although the detailed description of a preferred embodiment focuses on automatic translation of World Wide Web pages, the concept is adaptable to documents obtained from other sources.

The World Wide Web (WWW or the Web) is a distributed information system that may be accessed through a number of sources. It is comprised of software and a set of 10 protocols and conventions. Information on the Web may be accessed using a browser program such as CompuServe's Web Browser. Browsers allow users to read documents and to locate documents from other sources. They present an interface for interacting with the system and they process requests on behalf of the user.

Information providers on the WWW make their information available through 15 programs that understand the HyperText Transfer Protocol (HTTP). Browsers assist users in "visiting" Web sites where information is stored. Information is displayed in pages of text and graphics called "Web Pages." An example of a Web page as viewed through CompuServe's Web Browser is provided in Figures 1A and 1B. The Web page shown in Figures 1A and 1B contains both text 14, 18 and graphics 10, 12, 16. The title bar 20, menu options 22, buttons 20, 24, and document information 26 appearing at the top of the screen are part of the browser used to view the Web page.

In most cases, information providers make information available through a Web server. The server responds to information requests by delivering the requested information to the user's browser for viewing. Some providers may make their information available through a

proxy server that converts information in one format to the format expected and understood by the browser.

Documents available on the WWW and displayed by browsers are hypertext documents. Hypertext is text that contains references (or "links," "hyperlinks," or "hot spots") to other documents. The reference is similar to a footnote except the referenced document may be accessed directly from the original document. The related document may be viewed by selecting or clicking the mouse on the reference. The process of selecting hyperlinks to view referenced documents may be referred to as "traversing the hyperlinks." Unlike a footnote, references usually do not appear as shorthand descriptions of related documents. Instead, references may be indicated by a combination of graphics, different fonts, different colors for the text, underlining, the mouse pointer turning into a hand, etc. The referenced documents may reside on different computers at different Web sites.

Hypertext documents are written in a "markup language" call Hypertext Markup Language (HTML). HTML actually refers to both a document type and the markup language that represents instances of the document type. A hypertext document contains general semantics appropriate for representing display or presentation characteristics as well as information from a wide ranges of domains. A hypertext document consists of a sequence or stream of characters that comprise both data characters and markups. Markups are syntactically delimited characters (such as "<," ">," "#," etc.) added to the data characters to define the document's structure. Markups thus have special meanings and may represent such things as hypertext, news, mail, documentation, menus of options, and in-line graphics. Markups may be combined with other characters or related values to create codes that also have special meaning. Data characters are those characters in the document that are not codes.

Figure 2 is the hypertext document that describes the Web page shown in Figures 1A and 1B. Figure 2 shows the markups and related words (that comprise codes) as well as data characters that may appear in a hypertext document. For example, the characters "<" and ">" appearing throughout the document are markups. The characters "<" and ">" combined with 5 the word "head" ("<head>") 10 may be considered a code. Finally, the text "NLT Home" 10 that is not surrounded by markups or codes may be considered data characters.

As indicated by the brief description, HTML documents have a well-defined and documented structure defined by a grammar. The codes in a HTML document convey important information regarding both the display or presentation of the document itself as well 10 as related references and commands. Display and presentation information may include color information, information about graphics that appear on the page, information about text that appears on the page, etc. A HTML document is structured as a series of elements that are identified by the language markups and codes. A document includes a head (consisting of a title and other optional elements) and a body that is a text flow of paragraphs, lists, images, 15 and other elements. The various parts of the document may be identified by looking at the markups or codes in the document. For example, referring again to Figure 2 which shows the hypertext for Figures 1A and 1B, the document head contains the title "NLT Home" 10. An image contained in the document is identified in the line

"<br></center>" 12.

As may be apparent, the process of translating a HTML document requires examination of each character in document. Characters may be examined individually and in combination to determine whether they are markups, codes, or data characters. To process a document, the processing software examines the character stream that comprises the

document. The steps needed to translate a HTML document from one language to another may be summarized as follows:

5                   **Step 1.** Preprocess the HTML document by placing boundary markers around HTML codes to be preserved during the translation process. The translation software recognizes the boundary markers and does not translate text and symbols appearing between the markers.

10                  **Step 2.** Translate the preprocessed HTML document from the original language to the target language.

15                  **Step 3.** Postprocess the translated HTML document to remove the boundary markers.

15                  **Step 1.** The codes in a HTML document convey important information describing the characteristics of the Web page. Referring again to Figure 2, an example of the type of information contained in a hypertext document is shown. Certain information contained in the document of Figure 2 may be interpreted by a Web browser so that to the browser user, the images shown in Figures 1A and 1B appear. Certain information in the hypertext document is preserved during the translation process so that the translated page has, in general, the same appearance and behavior as the original page. Because HTML documents have a well-defined and known structure described by a grammar, automated translation of a HTML document is possible. The codes in the document may be discerned by the preprocessing software. Special 20 boundary markers placed in the document by the preprocessing software indicate to the translation software that the intervening text should not be translated. Consequently, the resulting page may have the same appearance and behavior as the original page.

Referring to Figure 3, an example of a preprocessed HTML document is shown. The HTML document of Figure 3 is the preprocessed version of the HTML document shown in

Figure 2. In this example, the boundary markers used to identify the HTML codes are the character pairs “{.” and “.}”. Any character or character combination that does not normally occur in text may be used as a boundary marker. The line that appeared as “<head><title>NLT Home<title><head>” in Figure 2 (10) is preprocessed in Step 1 to the line 5 “{.<head>.{.<title>.{>NLT Home{.<title>.{.<head>.” in Figure 3 (10). Other lines in the document are preprocessed similarly.

Step 2. Machine Translation (MT) software performs the translation of text from one language to another language. There are many commercially available MT software packages. Figure 4 is an illustration of a system in which MT software 10 takes as input text in one 10 language 12 and generates a rough draft translation of the text in another language 14 using an electronic dictionary 16 and a set of linguistic and/or statistical rules encoded in the program 18. MT software can perform language conversion operations very quickly; in some cases, at speeds of up to 3,000 words per minute. The translated texts are not high quality translations, but they are usually adequate for understanding what the document is about.

15 Referring to Figures 5A and 5B, an example of a translated HTML document is shown. The HTML document of Figures 5A and 5B is the translated version of the preprocessed HTML document shown in Figure 3. As described above, the boundary markers used to identify the HTML codes are the character pairs “{.” and “.}”. Consequently, the MT software ignores all text that falls between the boundary markers. Data characters that are not 20 surrounded by boundary markers are translated by the MT software. The preprocessed line that appeared as “{.<head>.{.<title>.{>NLT Home{.<title>.{.<head>.” in Figure 3 (10) is translated in Step 2 to the line “{.<head>.{.<title>.{>NLT Maison{.<title>.{.<head>.” in Figure 5A (10).

Step 3. In the final step, postprocessing software removes boundary markers from the translated document. Referring to Figure 6, an example of a postprocessed HTML document is shown. The HTML document of Figure 6 is the postprocessed version of the translated HTML document shown in Figures 5A and 5B. As described above, the boundary markers used to identify the HTML codes are the character pairs “{.” and “.}”. During postprocessing, these boundary markers are removed. The translated line that appeared as “{.<head>.{<title>.{NLT Maison{.<title>.{<head>.” in Figure 5A (10) is postprocessed in Step 3 to the line “<head><title>NLT Maison<title><head>” in Figure 6 (10). The postprocessed HTML document of Figure 6 may then be displayed by the browser as shown in Figures 7A and 7B.

Figure 8 is a diagrammatic view of one embodiment of the present invention in which machine translation is integrated into a Web browser. MT software 10 may be combined with a browser 12 to allow the user 14 to rapidly and automatically translate online documents from the World Wide Web 16 into his native language. The MT software 10 may be bundled with the browser 12 to form an integrated multilingual browser. The user 14 of the multilingual browser 16 selects the desired target language, (e.g. French if the user speaks French), and the Web document retrieved by the browser 18 may be rapidly translated on-the-fly with a mouse click. The Web Browser 12 then displays for the user 14 the translated document 20. Optionally, the user may be able to update and edit parts of the MT software's electronic dictionaries to include terminology common to the Web sites he visits.

Although a document may be translated at the time that a user requests access to the document, a document may also be “pre-translated” and stored in a cache for later retrieval before a user seeks access to it. Documents that have been accessed at least once may also be stored following translation. The advantage of storing documents that have been translated is

that delivery time to the user may be reduced. Although storing documents requires disk space, it may represent a better use of system resources because documents that are accessed frequently are translated once rather than every time they are accessed.

Figure 9 is a diagrammatic view of an alternative implementation in which pre-translated Web pages are stored on a Web server 14. The translation software resides on a translation server 14 (possibly the same machine as the Web server). Popular Web pages 24 are pre-translated and stored in a cache 28, with additional pages being added as they are requested by users 20. The cache is a dynamic storage device with a finite capacity. New, pretranslated pages are added to the cache, but pages will also be removed from the cache if they are used infrequently or if there are constraints on storage capacity.

In accessing the system, a user 10, sends to the Web Server 14 a request for a specific page in a specific language 12. The Web Server 14 then sends a request to get the desired page 16. The method for servicing the request depends on where the page is located. If the page has been pre-translated 24 and stored in the cache of pages in multiple languages 28, it is retrieved from the cache 26 and returned to the user in the requested language 30. If the page has not been pre-translated, then the page is retrieved 20 from the World Wide Web 22, translated into the requested language, and cached before being sent to the user 30.

Translation of Web pages, in either the bundled browser/MT configuration or the Web Server configuration, requires processing of HTML codes containing reference, command, and display information. Preferably, the HTML codes are identified prior to translation, then surrounded by special boundary markers to block the translation process on the codes. The HTML preprocessor uses its knowledge regarding the markups, codes, data characters and the structure of HTML documents to determine which codes should be blocked from the translation process. After translation is complete, a postprocessing program removes the

special boundary markers so that the necessary references, commands, and display characteristics are available in the translated text.

The primary objective of the present invention is to allow a user of the Internet to read hypertext documents that are available only in a language foreign to the user. The readable text of the hypertext document is changed in accordance with the user's preferred language. 5 Steps are taken to preserve the document's appearance and behavior so that the only noticeable difference between the original document and the translated document is the language of the text. Users may interact with the translated document and reference related documents in the same manner that users interact with the original document.

## WHAT IS CLAIMED IS:

1. A method for translating a document, comprising the steps of:
  - providing a character stream including codes and data characters in a first language;
  - 5 transmitting said character stream to a language translator;
  - recognizing said codes to prevent translation of said codes by said language translator; and
  - translating a significant portion of said data characters into a second language using said language translator.
- 10 2. The method of claim 1, wherein said codes are HyperText Markup Language codes.
3. The method of claim 1, wherein said step of recognizing said codes is performed by a language translator preprocessor.
4. The method of claim 1, wherein boundary markers are placed around said codes to prevent translation of said codes by said language translator.
- 15 5. The method of claim 1, wherein said language translator is integrated into a browser program.
6. The method of claim 1, wherein said document is pretranslated.
7. The method of claim 1, further comprising the step of viewing said translated HyperText Markup Language document with a browser.
- 20 8. A document translation system, comprising:
  - a character stream containing codes and data characters in a first language;
  - a preprocessor for marking codes in said character stream;
  - a language translator for translating into a second language said data characters in said preprocessed character stream; and

a postprocessor for unmarking said codes in said translated character stream.

9. The system of claim 8, wherein said codes are defined using HyperText Markup Language.
10. The system of claim 8, wherein said preprocessor, said language translator, and said postprocessor are integrated into a document browser.  
5
11. The system of claim 8, wherein said preprocessor, said language translator, and said postprocessor are integrated into a Web server process.
12. The system of claim 8, further comprising a browser for viewing said translated HyperText Markup Language document.
- 10 13. A method for translating documents, comprising the steps of:  
providing in a first language a document containing display and reference codes  
and data characters exclusive of said display and reference codes;  
viewing and interacting with said document in said first language;  
translating said data characters to a second language; and  
15 viewing and interacting with said translated document in substantially the same manner as said document in said first language.

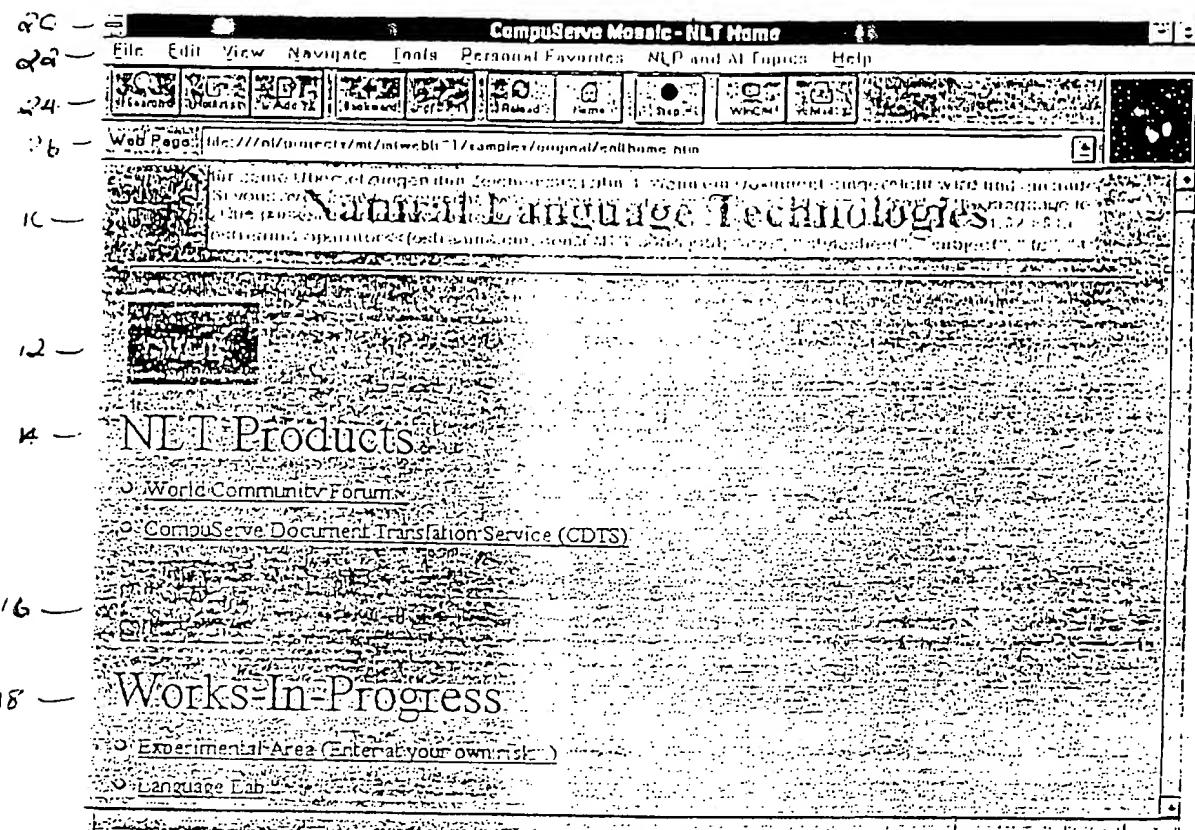


Figure 1A

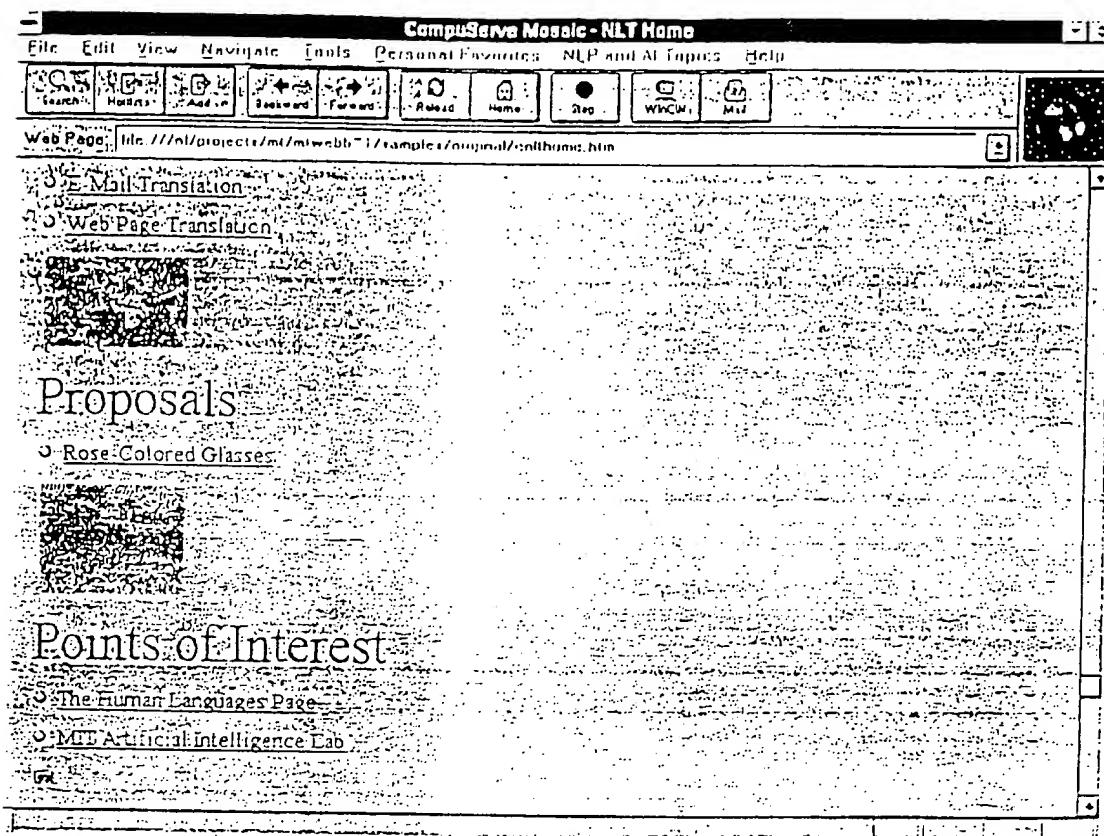


Figure 1B

10—  
12—

```
<html>
<head><title>NLT Home</title></head>
<br><center></center>
<hr>
<center><h1> </h1></center>
<br>
<h1>NLT Products</h1>
<br><UL><LI><a href="http://www.compuserve.com/cgi-bin/goserve?CIS:EWCFORUM">World Community Forum</a></UL>
<br><UL><LI><a href="http://www.compuserve.com/cgi-bin/goserve?CIS.TRANSLATE">CompuServe Document Translation Service (CDTS)</a></UL>
<center><h1> </h1></center>
<br>
<h1>Works-In-Progress</h1>
<br><UL><LI><a href="nlttest.htm">Experimental Area (Enter at your own risk...)</a></UL>
<br><UL><LI><a href="llab.htm">Language Lab</a></UL>
<br><UL><LI><a href="mailtran.htm">E-Mail Translation</a></UL>
<br><UL><LI><a href="webtrans.htm">Web Page Translation</a></UL>
<center><h1> </h1></center>
<br>
<h1>Proposals</h1>
<br><UL><LI><a href="http://jlammers/n/projects/proposal/rose_gf.doc">Rose-Colored Glasses</a></UL>
<center><h1> </h1></center>
<br>
<h1>Points of Interest</h1>
<br><UL><LI><a href="http://www.willamente.edu:80/~tjones/Language-Page.htm">The Human Languages Page</a></UL>
<br><UL><LI><a href="http://www.ai.mit.edu">MIT Artificial Intelligence Lab</a></UL>
<center><h1> </h1></center>
<br>
<p>Send comments/questions to: </p>
<br><a href="mailto:jlammers@csi.compuserve.com">NLT Mailbox</a>
</body>
</html>
```

Figure 2

4/12

10 — {. <html> }

{. <head> }{. <title> }NLT Home! </title> .}{. </head> }

{. <br> .}

{. <center> .}{.  .}{. </center> .}

{. <hr> .}

{. <center> .}{. <h1> .}{. </h1> .}{. </center> .}

{. <br> .}{.  .}

{. <h1> .}NLT Products{. </h1> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="http://www.compuserve.com/cgi-bin/gacserve?CIS:EWCFORUM"> .}World Community Forum{. </a> .}{. </UL> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="http://www.compuserve.com/cgi-bin/gacserve?CIS:TRANSLATE"> .}CompuServe Document Translation Service (CDTS){. </a> .}{. </UL> .}

{. <center> .}{. <h1> .}{. </h1> .}{. </center> .}

{. <br> .}{.  .}

{. <h1> .}Works-In-Progress{. </h1> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="nlttest.htm"> .}Experimental Area (Enter at your own risk...){. </a> .}{. </UL> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="llab.htm"> .}Language Lab{. </a> .}{. </UL> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="mailtran.htm"> .}E-Mail Translation{. </a> .}{. </UL> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="webtrans.htm"> .}Web Page Translation{. </a> .}{. </UL> .}

{. <center> .}{. <h1> .}{. </h1> .}{. </center> .}

{. <br> .}{.  .}

{. <h1> .}Proposals{. </h1> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="http://jammers/n/projects/proposal/rose\_gl.doc"> .}Rose-Colored Glasses{. </a> .}{. </UL> .}

{. <center> .}{. <h1> .}{. </h1> .}{. </center> .}

{. <br> .}{.  .}

{. <h1> .}Points of Interest{. </h1> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="http://www.willamette.edu:80/~jones/Language-Page.html"> .}The Human Languages Page{. </a> .}{. </UL> .}

{. <br> .}{. <UL> .}{. <LI> .}{. <a href="http://www.ai.mit.edu"> .}MIT Artificial Intelligence Lab{. </a> .}{. </UL> .}

{. <center> .}{. <h1> .}{. </h1> .}{. </center> .}

{. <br> .}{.  .}

{. <p> .}Send comments/questions to: {. </p> .}

{. <br> .}{. <a href="mailto:jammers@csi.compuserve.com"> .}NLT Mailbox{. </a> .}

{. </body> .}

{. </html> }

Figure 3

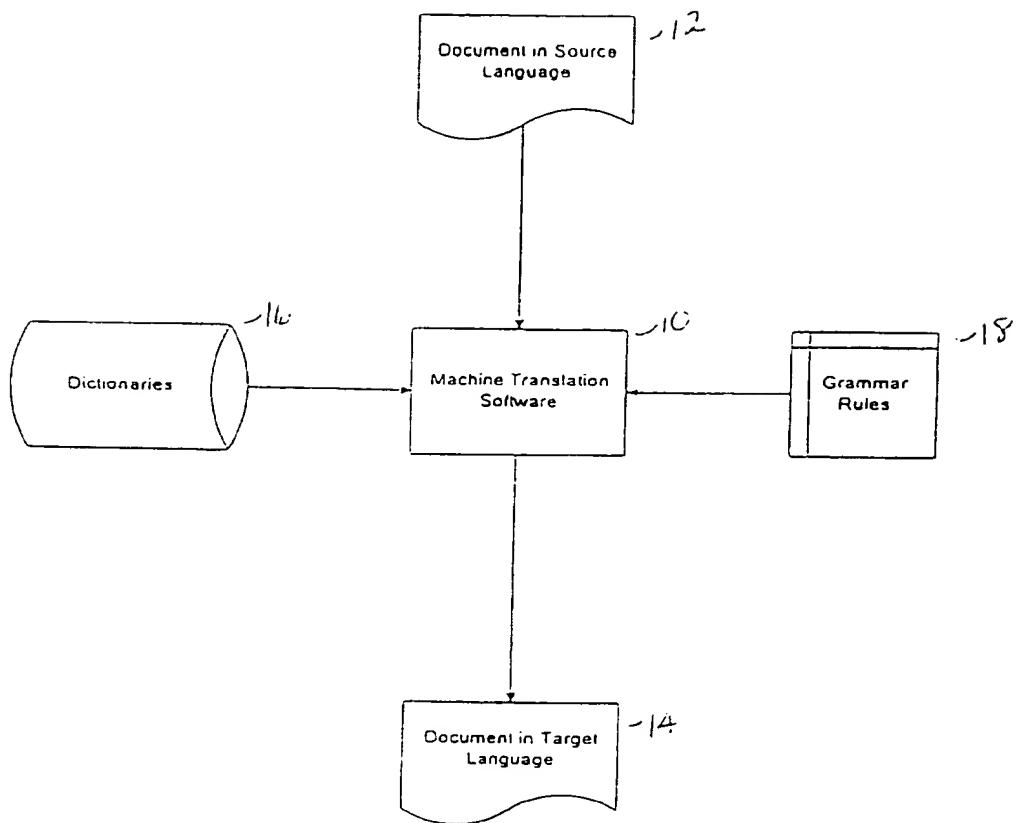


Figure 4

```

{.<html>.}

10 - |{.<head>.{.<title> }NLT Maison{.</title>}.{.</head>.}

{.<br>.}

{.<center>.{.}.{.</center>.}

{.<hr>.|{.<center>.{.<h1> .{.</h1>}.{.</center>.}

{.<br>.{..|

{.<h1>.)NLT Produits{.</h1>.}

{.<br>.){.<UL>.{.<LI>.{.<a
href="http://www.compuserve.com/cgi-bin/goeserve?CIS:EWCFORUM">.)Forum
Communauté globale{.</a>}.{.</UL>.|

{.<br>.){.<UL>.{.<LI>.{.<a
href="http://www.compuserve.com/cgi-bin/goeserve?CIS:TRANSLATE">.)Le
Service de Traduction de Document de compuServe (CDTS){.</a>}.{.</UL>.|

{.<center>.{.<h1> .{.</h1>}.{.</center>.}

{.<br>.{..|

{.<h1>.)Les travaux-dans-le progrès{.</h1>.}

{.<br>.){.<UL>.{.<LI>.{.<a href="nlttest.htm">.)Le Domaine expérimental
(Introduit à votre propre risque. ...){.</a>}.{.</UL>.|

{.<br>.){.<UL>.{.<LI>.{.<a href="llab.htm">.)Laboratoire de
langue{.</a>}.{.</UL>.|

{.<br>.){.<UL>.{.<LI>.{.<a href="mailtran.htm">.)Envoyer un message par
courrier électronique la Traduction{.</a>}.{.</UL>.|

{.<br>.){.<UL>.{.<LI>.{.<a href="wctrans.htm">.)La Traduction de Page
de toile{.</a>}.{.</UL>.|
```

Figure 5A

```
{.<center>.{.<h1>.{.</h1>}.{.</center>.}

{.<br>}.{..)Propositions{.</h1>.

{.<br>}.{.<UL>.{.<LI>.{.<a
href="http://jammers/n/projects/proposal/rose_g1.doc">.)Verres
Elevé-Colorés{.<a>.{.</UL>.

{.<center>.{.<h1> ){.</h1>}.{.</center>.

{.<br>}.{..)Les points d'intérêt{.</h1>.

{.<br>}.{.<UL>.{.<LI>.{.<a href="http://www.willamette.edu:80/~jones/Language-Page.html">.)La Page
de Langues Humaine{.<a>.{.</UL>.

{.<br>}.{.<UL>.{.<LI>.{.<a href="http://www.ai.mit.edu">.)MIT le
Laboratoire d'Intelligence Artificiel{.<a>.{.</UL>.

{.<center>.{.<h1>.{.</h1>}.{.</center>.

{.<br>}.{..)Les commentaires/questions d'envoi à: {.</p>.

{.<br>}.{.<a href="mailto:jammers@csi.compuserve.com">.)NLT Boîte à
lettres{.<a>.

{.</body>.

{.</html>.
```

Figure 5B

10 —

```

<html>
<head><title>NLT Maison</title></head>
<br>
<center></center>
<hr>
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(Introduit à votre propre risque. . .)</a></UL>
<br><UL><LI><a href="llab.htm">Laboratoire de
langue</a></UL>
<br><UL><LI><a href="mailtran.htm">Envoyer un message par
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<h1>Les points d'intérêt</h1>
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<br><UL><LI><a href="http://www.ai.mit.edu">MIT Ic
Laboratoire d'Intelligence Artificiel</a></UL>
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<br>
<p>Les commentaires/questions d'envoi à: </p>
<br><a href="mailto:jammers@csi.compuserve.com">NLT Boîte à
lettres</a>
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Figure 6

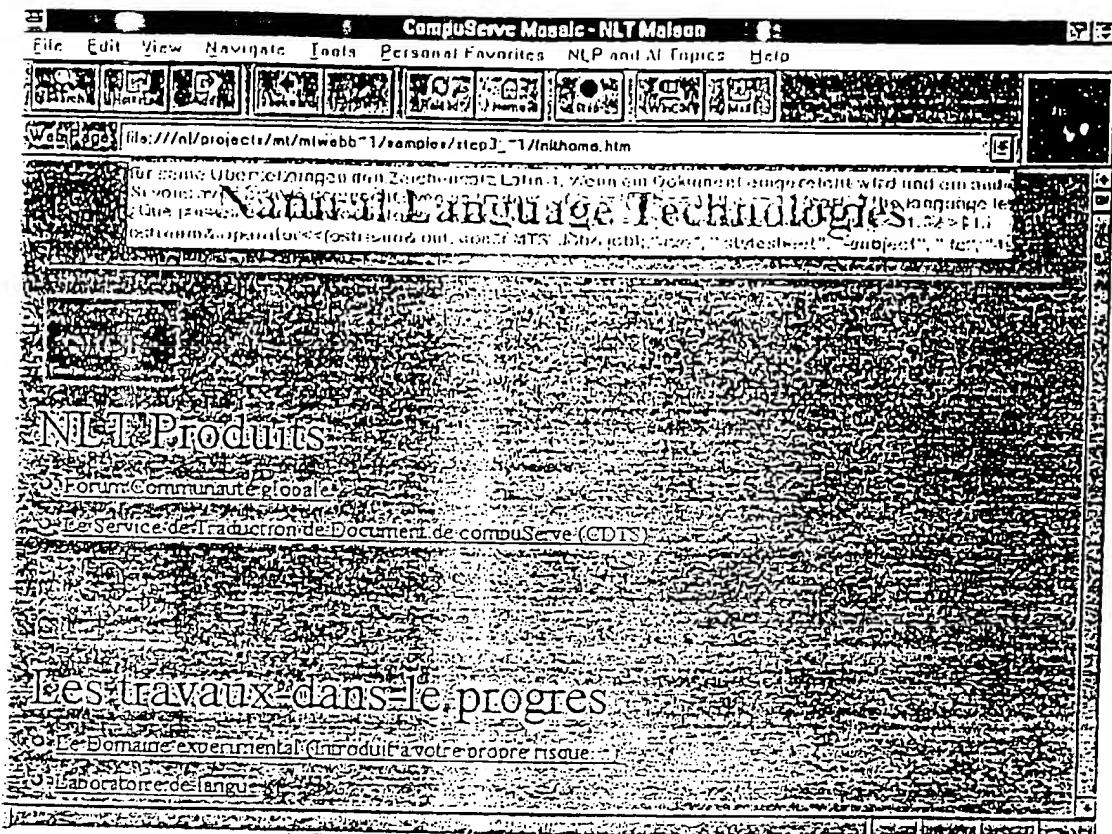


Figure 7A

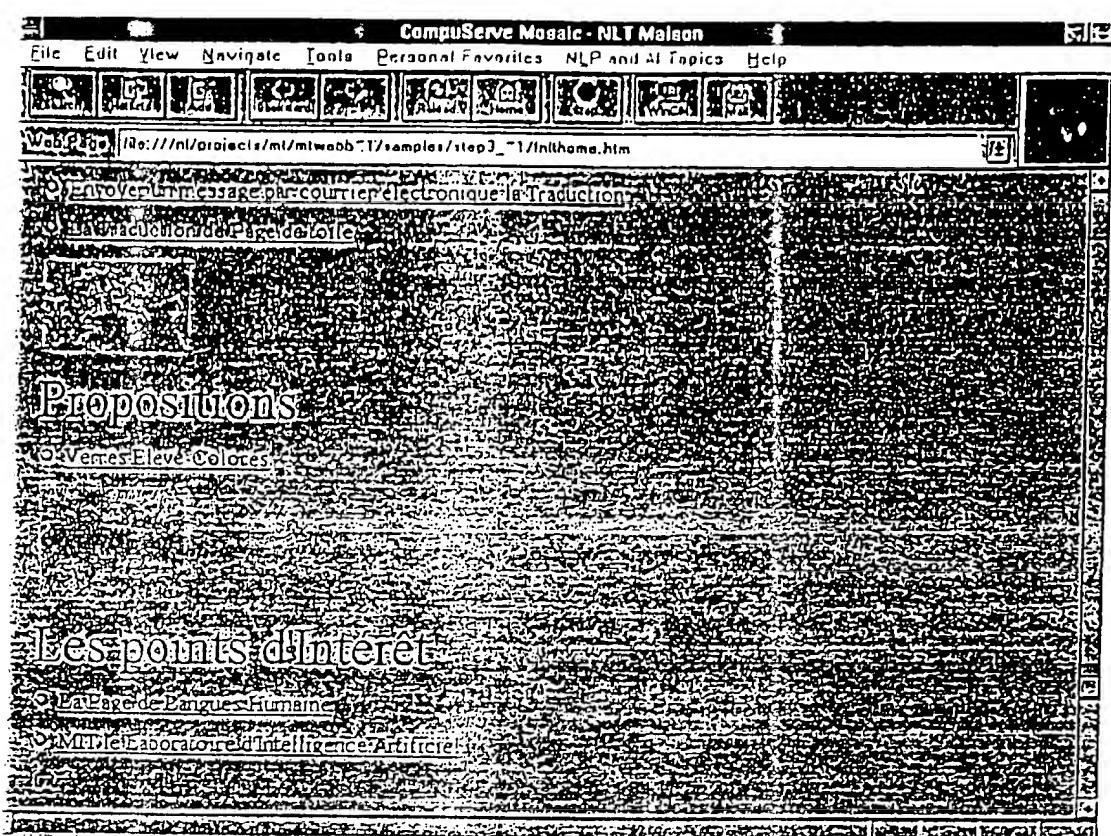


Figure 7B

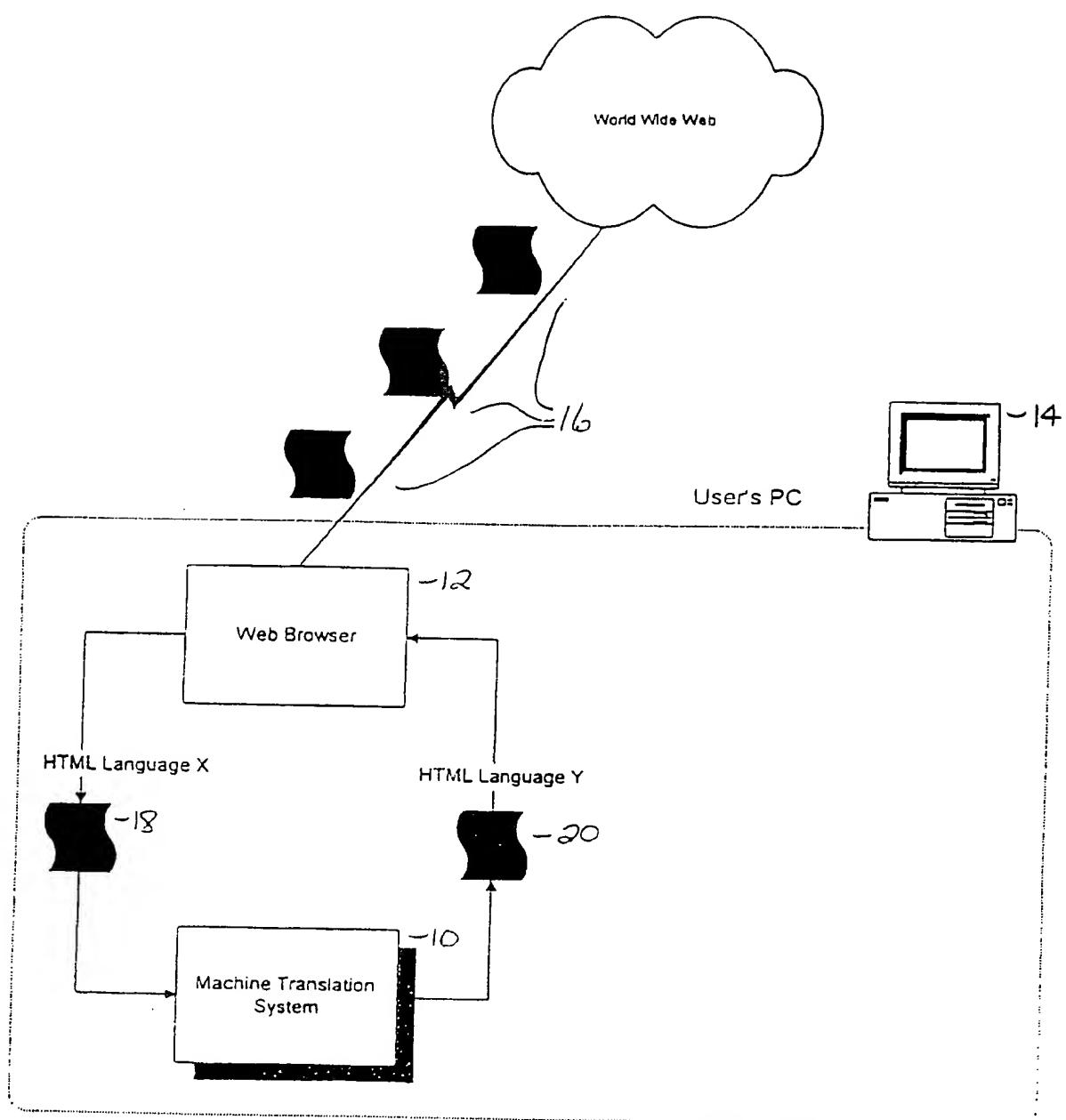


Figure 8

12/12

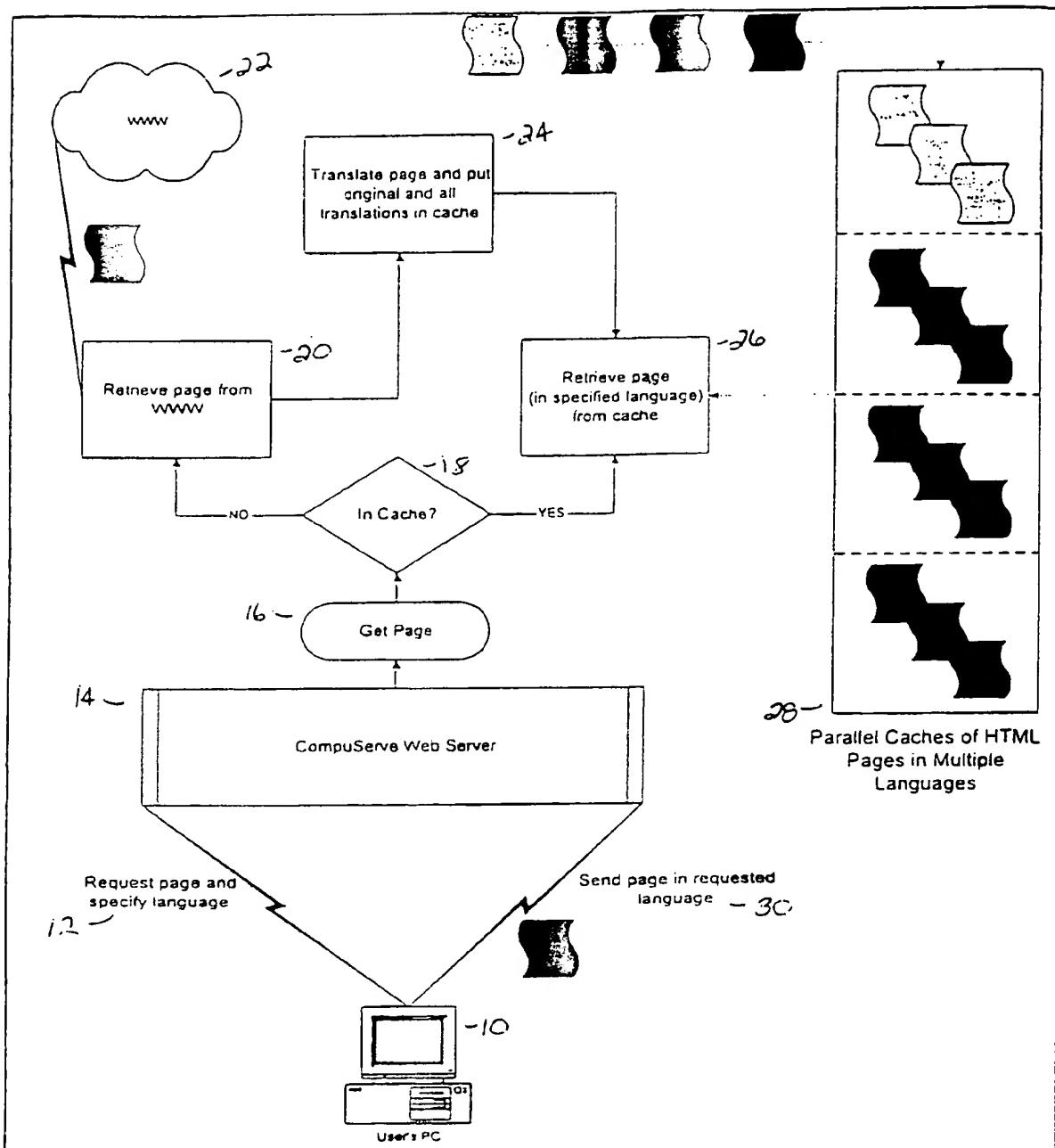


Figure 9

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US96/18102

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06F 17/28

US CL : 395/752

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/752, 754, 755, 756, 762, 774, 778, 791

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONEElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
NONE

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E	US 5,587,902 A (KUGIMIYA) 24 December 1996, see the abstract, figs. 1, 10, 12 and 18.	1-13
X,P	US 5,548,508 A (NAGAMI) 20 August 1996, see the abstract, figs. 1-4.	1-13
A	US 5,361,205 A (NISHINO ET AL) 01 November 1994, see the abstract.	1-13
A	US 5,243,519 A (ANDREWS ET AL) 07 September 1993, see the abstract.	1-13
A	US 5,373,442 A (KUTSUMI ET AL) 13 December 1994, see the abstract, fig. 4B.	1-13
A	US 5,005,127 A (KUGIMIYA ET AL) 02 April 1991, see the abstract, figs. 12-13.	1-13

 Further documents are listed in the continuation of Box C.  See patent family annex.

•	Special categories of cited documents:	
*A*	document defining the general state of the art which is not considered to be of particular relevance	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*E*	earlier document published on or after the international filing date	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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*O*	document referring to an oral disclosure, use, exhibition or other means	*&* document member of the same patent family
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Date of the actual completion of the international search

07 FEBRUARY 1997

Date of mailing of the international search report

14 MAR 1997

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John Hall